

SUPPURATIVE PERICARDITIS AND ITS SURGI-
CAL TREATMENT, WITH AN ANALYSIS
OF FIFTY-ONE CASES REPORTED
IN LITERATURE.

By CHARLES BURNHAM PORTER, M.D.,
OF BOSTON, MASS.,
SURGEON TO THE MASSACHUSETTS GENERAL HOSPITAL.

IN a previous study of the subject,¹ I collected twenty-four published cases beginning with the first case of recovery, the case of Rosenstein, operated upon in 1881. Of this number eight recovered and sixteen died, and in one the result was unknown.

In one case pericarditis developed one month after a wound. Many of the cases were complicated with left empyema, and twice the pericarditis was discovered at operation while draining the empyema. Of the fatal cases, two died at operation; one lived two days; one (Delorme's case) lived eight weeks after the operation.

The organisms found in the exudate were the staphylococcus aureus and streptococcus pyogenes, pneumococcus, and colon bacillus (in case of stab wound).

The amount of pus evacuated varied from ten ounces to two quarts. In one (Dickinson's case), it was brownish and thin with arterial blood; in two (Körte's and Eiselsberg's cases), foul and thick; in two (Newman's and Delorme's), thin. In the majority it was thick, creamy, without odor. In a number of cases, large fibrinous masses were found, the

¹Transactions of the American Surgical Association, 1897, Vol. xv, page 127.

pericardium being covered with thick layers of lymph. At autopsy in one fatal case (Pepper's), the whole sac was full of a thick mass of fibrin as large as the fist; the drainage had been good, and the heart probably failed from pressure of these fibrinous clots. The shortest case of healing of the sinus after drainage was nineteen days, the longest two months.

Preliminary aspiration was done in all these cases before opening the pericardium. In a number of cases paracentesis was done more than once, with and without injection of carbolic acid; and incision was finally resorted to owing to the rapidity of the reaccumulation. The immediate relief to pulse and respiration was almost always striking.

THE SURGICAL ANATOMY OF THE PERICARDIUM.

All authorities agree as to the great variations in the line of reflection of the pleura and pericardium.

Sick found that in the adult, out of twenty-three cases, the pleural reflection at the level of the fifth rib cartilage lay either at or within the left border of the sternum in seventeen; at the level of the sixth cartilage the pleural border had not gone beyond the sternal border in ten; at the level of the sternal articulation of the seventh cartilage it was in nine cases at the sternal border, or this cartilage was below its lower border. Twice it was less than one centimetre from the sternal border.

In twelve children, Sick found that, at the level of the fifth rib cartilage, the pleura was either within or just at the sternal border in eleven. At the level of the sixth cartilage the pleura had not left the sternal border eight times.

It will thus be seen that, according to Sick's careful observations, even at the fifth space the reflection of the pleura will often be behind the sternal border. Brooks (quoted by Quain), in four out of seven quite healthy cases, found the left pleural reflection entirely behind the sternum, and in one at the sternal border.

According to Luschka (quoted by Quain), the pleura

normally diverges from the median line at the upper border of the fifth costal cartilage, so that at the level of the fifth cartilage it is one-fifth centimetre, at the sixth, two centimetres, and at the seventh, 3.5 centimetres, external to the left border of the sternum.

Delorme and Mignon found in thirty-two adults that in the fourth interspace the left pleural border was within the border of the sternum in seventeen. At the level of the fifth cartilage it lay fifteen times internal to the sternal border and seventeen times outside. In twelve cases at the fifth interspace the pleural border was at, or inside, the sternal; and in the sixth space the pleural border was outside the sternum in twenty-six cases, and at or within it in eight.

Dr. Thomas Dwight, Professor of Anatomy at Harvard University, agrees in the main with Sick's observations, but states that there are many variations, and that frequently it is possible to reach the pericardium through the fifth intercostal space and frequently not. Owing to the fact that the sixth intercostal space is small and narrow, and that even here the pleura often reaches the sternal border, he concurs with the writer in advising resection of the fifth costal cartilage, and if necessary the excision of a piece of the sternum opposite this cartilage.

The internal mammary artery, according to Quain, runs parallel to the sternum at a distance from it of one centimetre. Delorme and Mignon, in thirty cases, found it a distance from the sternum of from one-half to two centimetres, the distance averaging about the same in the first six interspaces.

In looking over the arrangement of the left pleura by Dwight, Delorme, Sick, Quain, and Testut, all agree that there is a varied arrangement. Below the fourth intercostal space in the majority there is a slight interspace close to the border of the sternum which is free from pleura. In twenty-two operations on the cadaver by myself it was found that the removal of the fifth intercostal cartilage, and the removal of half an inch of the sternum opposite the sternocostal joint,

gave free access to the normal pericardium near its lowest level.

Three of the methods of operation which have been proposed and practised, namely, trephining the sternum (Riolan), approach through an intercostal space, and epigastric incision (Larrey), should all be discarded, as it will be evident from the above account of the anatomy that in all of them there is danger of wounding the pleura or diaphragm.

In this earlier work I decided that operation was indicated in all cases of purulent pericarditis, and perhaps in serous pericarditis in cases where aspiration, once or twice repeated, is followed by reaccumulation of the fluid; and the following "ideal operation" was planned after careful consideration and experiment on the eadaver in order so far as possible to meet the following indications:

(1) To avoid opening the pleural cavity. This may be made more easy by adhesions as a result of tapping or inflammation.

(2) To open the pericardium opposite the point where drainage will remain good after the sac has contracted.

(3) To secure permanent and free drainage.

The steps of the operation are

(1) An incision from the middle of the sternum outward over the fifth costal cartilage to its junction with the rib.

The soft parts are cleaned from the cartilage with periosteum elevator, care being taken not to wound the pleura on the under surface. The cartilage is divided with bone forceps from the rib and the sternum. The internal mammary artery and vein are thus exposed, ligated in two places, and divided between. The triangularis sterni is separated from the sternum and pushed to the right.

A little careful dissection with the director in case fat is encountered exposes the pericardium, which is normally much thicker than the pleura. An aspirating needle should now be introduced, if this has not been previously done, in order to corroborate the diagnosis. If confirmed, the knife should follow the needle. The incision in the pericardium is

best made obliquely downward and outward, beginning close to the excised border of the sternum. The edges of the pericardium should be stitched to the soft parts.

Irrigation should always be employed, with the object of removing any masses of fibrin which may lie at the bottom of the cavity; and if there are many such masses, it should be continued until the fluid returns clear.¹ The fluid may be weak sublimate or carbolic solution, or salt solution, according to the preference of the operator. The fluid must be warm, and must have free exit.² With this exception no harm has resulted from irrigation, which has been practised in more than half the cases.

Drainage is best provided by two rubber tubes, one long and reaching to the bottom of the sac for the inflow, and a short tube just entering the sac for the outflow. As the discharge diminishes, one tube may be removed, and finally gauze drainage inserted. Gauze drainage has proved adequate from the first, but where the fluid is thick or flocculent, tubes give the only adequate facilities for the subsequent daily irrigation.

The after-treatment must, of course, be directed to two ends: first, systemic treatment, consisting of forced feeding and free stimulation, and second, the care of the wound and the maintenance of drainage. The wound should be irrigated daily, and the patient, if his strength is sufficient to allow it, turned on his stomach to afford drainage.

Roberts, of Philadelphia, also, before the meeting of the American Surgical Association in 1897, presented an elaborate and exhaustive review of this subject. In this report he advocates the method of turning up a flap consisting of portions of the fourth and fifth left costal cartilages with the attached soft parts, thus exposing the field of operation. This method he had never followed on the living subject. Roberts collected

¹ Delorme's case, in which at autopsy two handfuls of fibrin were found in the pericardium.

² Parker's case; death on table from distention of sac by irrigating fluid.

thirty-five cases from all literature up to June, 1897, including my own case.

The previous work of the writer and the careful paper by Roberts brought the collected knowledge of this subject up to the summer of 1897, and leave us nothing further to do than search the work of the last three years, and make our final conclusions and analyses.

Voinitseli-Sianojewsky, of St. Petersburg, in 1897 (*Annales de Chirurg.*, Russe, 1897, xiii, ii, f. 3; also *Revue de Chirurgie*, 1898, Vol. xviii, p. 993) contributed a long study on the anatomical questions in pericardotomy, but added nothing new to the conclusions of Delorme and Mignon or to the anatomical studies of the writer given above. He refers to a case of incision in the second intercostal space for suppuration in the pericardium done by Bexman, of Russia, in 1891, with recovery. This case is not mentioned so far as known elsewhere. He refers to a number of different methods of incision, and the advocates of each as known to him.

(Through the third intercostal space,—Sievens.

Through the cartilage of the fourth rib,—Eiselsberg.

Through the fourth space,—Rosenstein, Orlow, Minine, Bronner, Parker, Klefberg.

Through fifth rib cartilage,—Ollier, Gussenbauer, and Körte.

Through fifth space,—West and Davidson.

Desault and Robinson, as well as he himself, advise operation through the sixth rib and sixth space.

Del Vecchio resects fourth and fifth ribs and cartilage, also Roberts.

Delorme and Mignon the fifth and sixth, Riolan, Laennec, Skielderup, and P. Malle propose to trephine the sternum in the median line.

Velpeau, Pirogoff, Baizeau, Delorme, and Mignon think it unnecessary to keep to left side of the sternum, while Desault, Romero, Karanaeff, Troussseau, and Tillaux advise it. Rotch, Wilson, and Dickinson chose fifth space on right side for tapping.)

He claims to have had the opportunity of studying post-mortem twenty cases of pericardial effusion, and to have done 100 pericardial operations on the dead; and on this experience he declares that incision through the sixth costal cartilage will *always* avoid the pleura (which is not an accurate statement), and his proposed method of operation is to go through the sixth cartilage and, if necessary, cut away some of the seventh cartilage also.

He states that open incision in all cases of pericardial effusion (not only in purulent cases) should be much preferred to puncture, because of the danger of wounding the heart and pleura by any method of using a needle.

Eichel, in 1899 (*Die Schussverletzungen des Herzens*, *Archiv f. klin. Chir.*, Band lix, Heft 1, 1899; also *ANNALS OF SURGERY*, Vol. xxx, p. 658, 1899), gives a fairly complete *résumé* of the anatomy of the pericardium and pleuræ with several diagrams. This article is chiefly valuable as showing that the most modern anatomical work does not change the accepted views of 1897 as given by me. In his paper he makes reference to all the latest foreign works upon anatomy. (*Lehrbuch der Topographische Chirurg. Anatomic* von Joessel und Waldeyer, Bonn, 1899; also Ferrier et Reynaud, "Surgery of Heart and Pericardium," Paris, 1898.)

He recommends pericardotomy for all effusions as well as for all wounds. He gives several interesting cases of operation for wounds and the resulting haemorrhage into the pericardium.

The use of tubes for drainage after haemo- or pyopericardium operations Eichel opposes; stating that he had a case in which he could not keep the ends of the tubes from impinging on the heart wall and causing stormy and irregular action. He says that Riedel had a case that taught him the same thing (refer to Riedel, *Verhand. der Deutsche Gesellschaft für Chir.*, 26th Cong., 1897, S. 72; also *Centralblatt f. Chir.*, 1897, p. 56).

A point which is of great importance, and which Breutano and Schaposchnikoff lay great stress upon,—viz., the anterior

situation of the heart in all effusions into the pericardium, is denied by Eichel. In his cases, he says, there was plenty of fluid between the heart wall and the anterior wall of the pericardium.

Brentano (*Deutsche med. Wocheuschrift*, 1898, xxxii, p. 506) reports five cases of operation for pericarditis, and discusses this question as to the situation of the heart when the pericardium is more or less full of fluid, whether it is nearer to the posterior than the anterior wall. From his clinical experience, Brentano decides that in all pericardial effusions the heart is situated down and forward, and most often lies right against the anterior wall of the sac even when no adhesions exist, and that in many cases there will be adhesions between the pericardium and the anterior wall of the heart. In all cases most of the pericardial fluid is behind. If this anterior situation of the heart is a fact, the danger of wounding the heart wall in all cases of paracentesis is great.

Brentano advises open incision in any effusion, with resection of the fifth costal cartilage. In fact, this seems to be the growing thought in the last few years,—that incision through a resection of the fifth left costal cartilage is a far safer operation than paracentesis.

Schiaposchikoff, in 1898 (*Russisch. Archiv f. Pathologie klin. Med. und Bacteriologie von Padw.*, July, 1896; also *Deutsche med. Wocheuschrift*, 1898, No. 38, p. 611), agrees entirely with Brentano on this question. He states that he has studied the point for twenty-seven years clinically, post-mortem, and experimentally, and has proved that the heart is in all cases forward against the sac wall.

Brentano recommends almost the identical procedures of my own technique, viz., stitching of the sac to the skin, and irrigation; for drainage, however, he always used iodoform ganz, not tubes.

He decides that opening the pericardium through a resection of fifth rib cartilage is very simple, and advises against puncture in any case. Local anaesthesia with cocaine is all that is needed in most cases. In regard to this question,

Körte, speaking at the Freie Vereinigung des Chirurg. at Berlin, December 13, 1897 (*Deutsche med. Wochenschrift*, 1898, p. 170), favored the use of cocaine in many cases, but stated that, in certain cases of thick chest walls, ether or chloroform must be used. Brentano mentions as one of his chief arguments against puncture in cases of serous effusion that it is impossible to remove anywhere near all of the fluid by aspiration alone. Of eighty cases of paracentesis tabulated by West, in twenty-three the puncture had to be repeated.

Brentano reports five cases, which are as follows: All five were done by resecting the fifth rib cartilage; two were for purulent pericarditis following acute osteomyelitis in children seven years old. Operation was followed by temporary and marked improvement, but death occurred in twelve days from pyæmnia, as shown by autopsy.

In both cases there were found multiple abscesses in the heart muscle itself, and in one the direct cause of death was from rupture of one of these abscesses into the left ventricle.

Two cases were for subacute scrofulinous pericarditis after rheumatic attacks and rheumatic endocarditis. Both died in three days.

The fifth was a brilliant case of open incision for simple serous pericarditis, without preliminary puncture.

These cases are given in full in the list of cases appended to this paper.

Delorme, in 1898 (*Gazette des Hôpitaux*, 1898, p. 1150), the same surgeon who collaborated with Mignon in 1895 in an article on the technique of pericardotomy (*Revue de Chir.*, September and October, 1895), recommends resection of the fifth rib cartilage to relieve mediastinal and pericardial adhesions whether or not due to tuberculosis, and also as the route to the pericardium in all cases.

H. Allingham (*Lancet*, March 10, 1900) brings forward an entirely new method of operation for draining the pericardium in suppurative cases, and also, with Ogle, of London, reports a case of purulent pericarditis operated on, though not by his suggested method. The case was one of purulent

pericarditis originating from a chronic abscess in the pleural cavity near the pericardium. Incision after resecting the fifth cartilage was followed by death in fourteen hours.

(This case is given in my list of cases.)

Allingham's suggested method, which he has tried on twelve cadavers but never on the living, is as follows: It is designed to give best access to the sac and best dependent drainage by opening the sac from below through the diaphragm.

I. An incision about three inches long, with its upper end at the costoxiphoid angle, is made along the lower edge

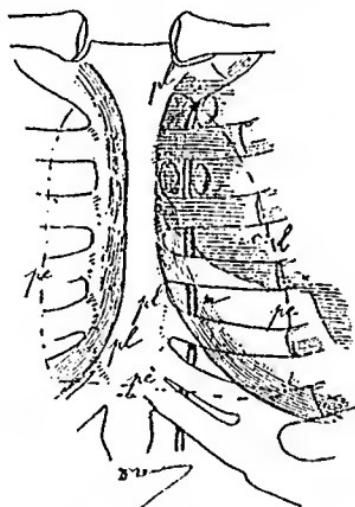


FIG. 1.—Normal contour of pleura and pericardium (Delorme and Mignon). *Pl*, pleura; *pe*, pericardium; *l*, border of lung.

of the seventh costal cartilage; the latter is then exposed by separating the abdominal muscles from it; the cartilage can then be pulled up and back, exposing the fibres of the diaphragm together with the cellular interval between its attachments to the cartilage and to the xiphoid appendix.

II. This cellular space is enlarged by cutting or tearing through the muscle of the diaphragm as far as necessary, when a mass of fat is usually seen just above the diaphragm in the space between the diaphragm below, the sternum in front, the

pericardium above and behind. This fat, together with the diaphragm, is then pulled down when the pericardium presents, and can be opened up at its lowest point.

During the operation the peritoneum may be exposed to a slight extent as it sweeps downward from the under surface of the diaphragm. It is, of course, not injured, being pushed away as in a suprapubic cystotomy.

The advantages claimed for this method are as follows:

I. The pleural cavity cannot be injured, as it is far away

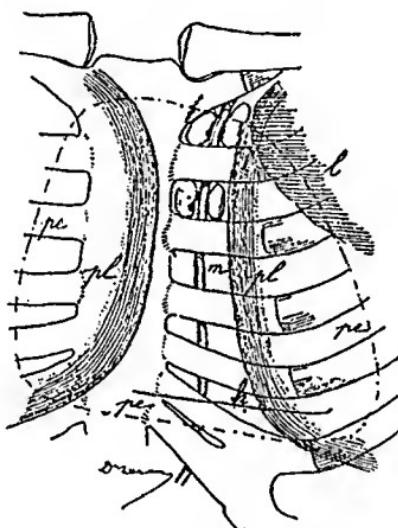


FIG. 2.—Line of pleura, abnormally to left of sternum (Delorme and Mignon). *PI*, pleura; *pc*, pericardium; *l*, border of lung; *h*, base of heart.

in the normal arrangement of the organs and farther off in pericardial distension. It is claimed that this is the only sure method of avoiding the pleura.

II. Drainage is through the most dependent part of the sac, through a large opening not limited by bone or cartilage.

III. Great ease of exploration and cleaning of the sac is afforded.

In certain fat subjects it may be necessary to cut away some of the seventh cartilage to get room in the xiphoid

space. (It is to be noted that Roberts has recommended this area as the point of election for puncture, though not for incision.)

Ljunggren (*Nord. Med. Ark.*, New Series, 1899, Vol. ix, No. 28, in a paper extracted briefly in *ANNALS OF SURGERY*, 1899, Vol. xxx, p. 659) reports a case of suppurative pericarditis successfully treated by incision and drainage. (The full details of the case will be given in the list of cases.)

He objects to puncture as a dangerous procedure in any case, recommending incision and drainage as the rational thing

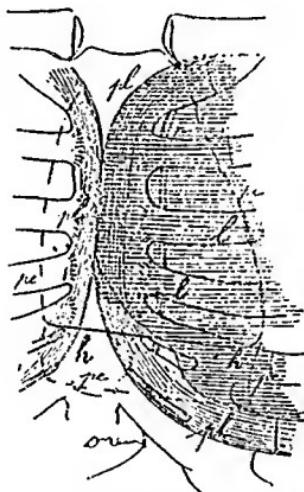


FIG. 3.—Left pleura, behind sternum, reaching beyond middle line (Delorme and Mignon). *pl*, pleura; *pe*, pericardium; *l*, border of lung; *h*, base of heart.

in all cases. He added six cases to Roberts's thirty-five, making forty-one in all; but four cases are inaccessible to us and doubtful. Of these, sixteen recovered and twenty-five died. Of the sixteen recoveries, eight were complicated by other diseases; in seven of the fatal cases death was due either to faulty methods or slowness in operating.

His eight rules for the technique of the operation do not differ from my published method. He uses rubber drainage-tubes double.

The pleura should be loosened with blunt dissector and sutured laterally to prevent infection of the pleural cavity. He mentions the occasional necessity of cutting away some of the sixth cartilage, after resecting the fifth, in order to get more room, but does not mention removing any of the sternum. General anaesthesia is not necessary, and in weak cases is contraindicated.

Lilienthal, of New York, in 1899 (*Journal of the American Medical Association*, 1899, Vol. xxxiii, p. 1422; also *Medical News*, November 23, 1899), reports a case of recovery from operation in a boy convalescing from lobar pneumonia; operation under cocaine local anaesthesia, forty ounces pus evacuated, giving cultures of pneumococci; this organism and streptococci were also in the sputum. (Details of this case are given in the list of cases.)

C. Mansell-Moulin, in 1897 (*Transactions of the Clinical Society*, 1897, Vol. xxx, p. 217), reports an operation for "haemopericardium," as he calls it. The case was successfully operated on about one month after a blow on the chest at football, and six pints of thin, dark, bloody fluid removed, from which no cultures were made. It seems reasonable to class this with purulent cases as certain other cases of suppurative effusion after injury (note the case of Riedel, also case of West). (The case is not very dissimilar from Eiselsberg's at the first aspiration.)

Sevestre, in 1898 (*Lancet*, April 23, 1898), reports a case of purulent pericarditis in the course of acute pneumonia. Cultures, pure pneumococcus. Operated on under cocaine anesthesia. Double empyema afterwards with resection of ribs on each side. Death. (See list of cases.)

In Sevestre's case, two aspirations were attempted before the incision was finally resorted to. At the second aspiration only bright blood was obtained (the query arises as to whether the heart itself was wounded). The operation through the fourth space seems to have been careless, and the empyema following may have been caused by the pericardial operation.

H. Betham Robinson, who reported his first ease in Transactions of the Clinical Society, Vol. xxx, has reported a second ease in 1898 (*British Medical Journal*, November 26, 1898, Vol. ii, p. 1605). A case following bronchopneumonia in a child four years old. Death in three days. (See list of eases.)

Several recent elaborate papers given in the bibliography deal with surgery of the heart itself or with the surgery of wounds of the pericardium.

Loison, on wounds of the heart and pericardium, an exhaustive paper in *Revue de Chirurgie*, 1899, Vol. xix, gives in his table four cases of pericardiotomy for wounds of pericardium, viz., cases of Cappelen, Eiselsberg, Garber, and Riedel. Two of these, Eiselsberg's and Garber's cases, are eases of operation for suppuration following wounds.

A new method of opening the chest in surgery of the heart and pericardium is advanced by Wehr. (*Archiv f. klin. Chirurgie*, Band lix, p. 949.) He recommends it especially where large exposure is necessary in wounds of the heart itself. It consists of making an elliptical flap of skin, bone, and cartilage, cutting across sternum at base of fourth cartilage, and again at xiphoid joint, and by curving sweep take in fourth, fifth, sixth, and seventh costal cartilage, turning this flap back with the right edge of the sternum as a hinge. He does not say he has done this on the living.

Manges, of New York, in 1900, reported on eases of pericarditis following pneumonia at the Mt. Sinai Hospital (*Medical News*, January 20, 1900). In 500 cases, pericarditis developed in only eleven, and of the eleven, five died. He thinks all eases of pericarditis as a complication of pneumonia are due to the pneumococcus, and further states that infection with this organism is probably in many cases of so-called idiopathic pericarditis. This same organism finds its way from the pulmonary passages. In the pericardium, as in the meninges, the pneumococcus is always a pyogenic organism. It is probable, he says, that many cases of pericarditis in pneumonia are overlooked because the conditions around the heart, when the left lung is affected, are such as to obscure the most important

sign, viz., increase of heart dulness; the to-and-fro murmur of the pericardial friction may last but a few hours.

Connor and Stimson, of New York, in 1900 (*Medical News*, January 20, 1900), report a case of purulent pericarditis after a severe pneumonia. Operation under local anaesthesia by Dr. Stimson. The right pleura was cut accidentally; death in a few days from purulent pneumonia.

Ljunggren, in his paper (*loc. cit.*), after reporting his case, the history of which has been translated and put in my list of cases, goes on to say that he has found some new cases which are not in previous lists. Three of these cases are inaccessible, however, and are given thus by him with no details, he merely giving the references.

(Hirschsprung cited by Heyde. Heyde in a Dissertation auf Kiel, 1896. Perls in a Dissertation auf Strassburg, 1896.)

The other cases are those of Brentano, which I have given.

It has been possible for the writer to add fourteen cases to the former collections of my own and Roberts, without counting the above three cases cited by Ljunggren, the details of which are not to be had. These make a total of fifty-one cases. Of this series of cases the annexed tabular view has been made.

An analysis of the fifty-one cases gives the following facts:

Forty-six were for purulent pericarditis, septic; two were for serofibrinous pericarditis, rheumatic; one was for haemorrhagic pericarditis, traumatic; two were for serous pericarditis.

The etiology is as follows:

Pneumonia with and without empyema.....	14
Bronchopneumonia (in a child).....	1
Osteomyelitis	5
Wounds, gunshot or stab.....	4
Blow on chest.....	1
Periostitis	1
Necrosis of nasal bones.....	1
Septic throat.....	1
Septic arthritis of knee.....	1
Abscess of buttock.....	1

Empyema without pneumonia.....	5
Pleurisy of doubtful origin.....	2
Pleurisy with typhoid fever.....	1
Pleurisy with bronchitis.....	1
Influenza	1
Tuberculosis(?)	2
Unknown origin.....	7
Rheumatic fever and endocarditis more or less acute.....	3

Of the total fifty-one cases of incision for pericarditis, twenty recovered and thirty-one died,—a mortality for all cases of 60.5 per cent.

Of the two operations for simple serous pericarditis both recovered.

Of the fourteen cases in which acute pneumonia, either lobar, bronchial, or septic, was the cause of the purulent pericarditis, only four recovered (cases of Bohm, Lilienthal, Porter, and Bjorkmann); in two of these the pneumococcus was cultivated from the pus. The other two report no bacteriological studies.

Twenty cases were not tapped previous to operation. Local anaesthesia with cocaine or eucaine was used in six cases.

CONCLUSIONS.

(1) Pericardotomy is indicated in all cases of suppurative pericarditis.

(2) Because of the uncertain and varying relations of the pleura, and because of the anterior position of the heart whenever the pericardial sac is distended by fluid, aspiration of the pericardium is a more dangerous procedure than open incision when done by skilled hands.

(3) Incisions of the pericardium can be done quickly and safely by resection of the fifth costal cartilage, and in many cases under local anaesthesia.

(4) In many cases of serous effusion, open incision without puncture will offer less risk and speedier cure than aspiration.

(5) The method and detailed technique of the writer pro-

posed in 1897 have been followed out by the majority of recent operators.

CASES OF SUPPURATIVE PERICARDITIS TREATED BY INCISION.

CASE I.—(Hilsmann, "Ueber die Paracentese des Pericardiums," Kiel, 1875, Inang. Dissert.) Date of operation, 1844. Male, aged twenty-five years. Ill eight months. No complications. Not tapped previously. Incision fourth interspace, a finger's breadth from left edge of sternum. Four tumblersfuls of pus evacuated; much more escaped within a few hours after operation. No irrigation of pericardium. Permanent drainage, wound kept open by inserting probe. After-treatment, nearly three months. Recovered. The pericardium was opened behind the sternum, though the external wound was a short distance to left of sternum. As the sac was gradually drained, its walls contracted and the pericardial opening moved to the left. In a few days the opening was one and one-half inches to left of sternum and over the fourth rib. In order to empty the sac thoroughly when the external wound was dressed, the patient had to bend over as if he was about to stand on his head.

CASE II.—(Langenbeek, *Vorlesungen über Chirurgie*, Berlin, 1888, p. 449.) Date of operation, 1850. Gunshot wound and necrosis of ribs. Not tapped previously. Incision where fifth rib was destroyed. No irrigation. Recovered. Patient had been wounded in a duel in which the bullet shattered five ribs. Necrosis had subsequently occurred, and purulent pericarditis resulted.

CASE III.—(Rosenstein, *Berlin. klin. Wochenschrift*, January 31, 1881, p. 62.) Date of operation, 1879. Male, aged ten years. Ill twenty-eight days. Pleuritis a complication. Tapped twice a few days previously with aspirator; pleura also tapped. Incision fourth interspace near sternum. Great quantity of pus evacuated. No irrigation. Permanent drainage with two drainage-tubes. After-treatment, about two months. Recovered. Pleuritis apparently occurred after tapping and incision of pericardium.

CASE IV.—(West, *Medico-Chirurgical Transactions*, 1883, p. 235.) Date of operation, 1882. Male, aged sixteen years. Ill one month. No complication. Tapped three days previously. Incision, fifth interspace, in line of left nipple. Two quarts of pus evacuated. Irrigation, carbolic acid solution, 1 to 40. Permanent drainage with drainage-tube. After-treatment, five months. Recovered. Rod-shaped bacteria found in pus. Patient in good health nine years afterwards. West believes that pericardial adhesions had occurred, but there was no evidence of this condition.

CASE V.—(Partzhevsky, *London Medical Record*, February 15, 1883, p. 33.) Date of operation, 1882(?). Male, aged twenty-three years. Ill thirteen weeks. Pleuritis a complication. Tapped twice. Incision, fourth interspace. Irrigation, salicylic acid solution. Permanent drainage with drainage-tube. After-treatment, thirty hours. Death. Autopsy showed cardiac hypertrophy with fatty degeneration, pleural adhesions, and pulmonary edema.

CASE VI.—(West, *British Medical Journal*, December 8, 1883, p. 1129, and February 21, 1891, p. 404.) Date of operation, 1883. Male, aged fourteen years. Pleuritis, pneumonia, abscess of thigh, arthritis were complications. Pericardium opened with bistoury, from wound made to evacuate a supposed pleural effusion. Twenty-four fluidounces of pus evacuated. After-treatment, fourteen days. Death. At autopsy found extensive pericardial adhesions.

CASE VII.—(Savory(?), reported by Brinton and Collins, *St. Bartholomew's Hospital Reports*, 1883, Vol. xix, p. 271.) Date of operation, 1883. Male, aged nine years. Ill seven weeks. Abscess of shoulder and thigh, pleuritis and pneumonia as complications. Serum obtained from pleura at two previous tappings. Incision, fifth interspace in anterior line of axilla through pleural cavity, which was opened because effusion believed to be pleural. Twenty-four fluidounces of pus evacuated. Irrigation, Condy's fluid. Permanent drainage with drainage-tube. After-treatment, fifteen days. Death. Case was one of pyæmia. Autopsy showed no communication between left pleura and the track leading through it to pericardium, because adhesions had occurred.

CASE VIII.—(Scott, *New Zealand Medical Journal*, July, 1891, p. 268.) Date of operation, 1883. Male, aged six years. Ill five weeks. No complication. Tapped with trocar one day previously; irrigation with carbolic acid solution, 1 per cent. Permanent drainage; two openings an inch apart, with drainage-tube through both. Recovered.

CASE IX.—(Newman (or Sterling), *Australian Medical Journal*, July 15, 1885, p. 303.) Date of operation, 1885. Male, aged thirty-two years. Ill two months. Typhoid fever and pleuritis were complications. Aspiration, five times; fifth time silver canula allowed to remain for drainage; at fifth tapping, carbolic acid solution and tincture of iodine solution used for irrigation; first aspiration one month previously. Incision, third left interspace; incision made where fistula existed from canula, which had been draining the sac for three days. One hundred and seventy-four fluidounces of pus had been evacuated by five previous tappings. Irrigation with tincture of iodine. (British Pharmacopœia, 1-10.) Permanent drainage with rubber tube. After-treatment, five days. Death. First aspiration was done in sixth left interspace; second, in fourth right interspace; in third and fourth aspirations no information as to point is given; fifth tapping done in third left interspace. At autopsy a sinus found in second interspace leading from pericardium to the subcutaneous tissue.

CASE X.—(Mikhailov, *Med. Oboz.*, Moscow, 1885, Vol. xxiii, p. 475; ANNALS OF SURGERY, November, 1885, quoted from *London Medical Record*, August 15, 1885.) Date of operation, 1885(?). Female, aged thirty-five years. Ill about three weeks. Pleural, bronchial, and renal lesions as complications. Tapped two days previously. Incision, fourth interspace, near sternum. Two fluidpounds(?) of pus evacuated. Irrigation with boric acid solution. Permanent drainage with drainage-tube. After-treatment, eighteen hours. Death. Autopsy showed cardiae dilatation with fatty degeneration, pleural and bronchial disease and kidney

lesions. Bacteriological examinations of heart and pericardium were negative.

CASE XI.—(Gussenbauer, *Wiener med. Wochenschrift*, November 22, 1884, p. 1403.) Date of operation, 1885 (?). Male, aged thirteen years. Acute osteomyelitis of left shoulder as complication. Incision, fifth rib resected, pericardium opened through pleural cavity because effusion was supposed to be pleural. Irrigation with thymol solution. Permanent drainage by stitching pericardium to edges of wound. Recovered. Small fistula remained when case was reported.

CASE XII.—(Ronse (Dickenson's patient), *Transactions of the Clinical Society*, London, 1889, p. 48.) Date of operation, 1887. Male, aged ten years. Ill about fifteen weeks. Gluteal abscesses, pleuritis, abscess of finger as complications. Pleura tapped twelve times; serum obtained. Tapped pericardium three times; last time one week previously. Incision, fifth interspace, right side, close to sternum. No irrigation. Permanent drainage with drainage-tube. After-treatment, two and one-half months. Recovered. Case considered one of pyæmia. Patient lay on face at times to encourage drainage.

CASE XIII.—(Underhill, *Edinburgh Hospital Reports*, 1896, iv, p. 200.) Date of operation, 1887. Female, aged six years. Ill two days. Pyæmia; had periosteal abscess of tibia a few weeks previously; autopsy showed abscesses in kidneys and pleura. Aspirated twice, last time five days before incision. Incision, fifth left interspace, close to border of sternum. Over ten fluidounces of pus evacuated. No irrigation. Permanent drainage with drainage-tube. After-treatment, five days. Death. Several haemorrhages from interior of pericardium. Autopsy showed that the bleeding probably came from granulation-tissue on inner surface of pericardium, probably the seat of septic emboli.

CASE XIV.—(Parker, *Transactions of the Clinical Society*, London, 1889, Vol. xxii, p. 60.) Date of operation, 1888. Female, aged nine years. Ill six and one-half weeks. Osteomyelitis of tibia and suppurative arthritis of knee as complication. Tapped four days previously. Incision, fourth interspace along left border of sternum, with resection of one inch of fifth costal cartilage. A large quantity of pus and lymph evacuated. Irrigated. Permanent drainage, pericardium stitched to edges of wound. Death occurred during irrigation, immediately after incision. Pus did not flow well; it was thick, and contained membraniform shreds; hence irrigation was adopted. Operator believed death was caused by irrigating fluid collecting in the pericardium, as the opening in the pericardium became plugged with lymph. Pressure on heart proved fatal. Patient was pyæmic. No special lesion found in chest at autopsy, except pericardial changes.

CASE XV.—(Halsted, *University Medical Magazine*, Vol. vi, p. 248.) Date of operation, 1890. Male, aged thirty-six years. Ill over three weeks. Acute necrosis of bones of nose, albuminuria, and congestion of right lung as complications. Not tapped previously. Incision, fourth interspace midway between nipple and sternum. Over a quart of pus evacuated. No irrigation. Permanent drainage with gauze plug. After-treat-

ment, seventeen days. Death. Great improvement after operation. Dr. Osler, who reports ease, calls the pericarditis septie, and attributes the fatal result to a probable myocarditis. No autopsy was made.

CASE XVI.—(Delorme, *Revue de Chirurgie*, 1895, Vol. xv, p. 1008.) Date of operation, 1890. Male. Ill eighteen days. Double pleuritis as complication. Empyema operation. Not tapped previously. Incision, fourth interspace, a little outside of internal mammary vessels. A few drops of pus evacuated. No irrigation. After-treatment, a few moments. Death. Patient died of asphyxia, which had caused the pericardial operation to be hurriedly undertaken. Autopsy showed front of heart adherent to pericardium, and about 500 grammes of seropis collected at the base and sides of the heart, and a great quantity of false membranes that could only have been removed by a large opening, followed by washing and direct extraction. The opening in the fourth space was over the adherent region.

CASE XVII.—(Davidson, *British Medical Journal*, March 14, 1891, p. 578.) Date of operation, 1890. Male, aged six years. Ill over four weeks. Metatarsal neerosis, subperiosteal abscess at eighth rib on right side; empyema, pneumonia as complications. Not tapped previously. Incision, at fifth interspace. Eight fluidounces evacuated. No irrigation. Permanent drainage with drainage-tube. After-treatment, seven days. Death. Autopsy showed no pericardial adhesions; pneumonia. Case was considered septie.

CASE XVIII.—(Davidson, *British Medical Journal*, March 14, 1891, p. 578.) Date of operation, 1890. Male, aged six and three-fourths years. Ill nearly four weeks. Empyema as complication which had been operated upon. Pericardium not tapped. Incision, fourth interspace, one inch from left edge of sternum. Several fluidounces of pus evacuated. No irrigation. Permanent drainage with draining-tube. After-treatment, over seven weeks. Recovered.

CASE XIX.—(Teale (Bronner's patient), *British Medical Journal*, February 14, 1891, p. 350.) Date of operation, 1890. Female, aged eleven years. Ill thirty-four days. Influenza, pneumonia, empyema as complications. Empyema operated on previously. Incision, without aspiration, through fourth interspace one inch from left border of sternum. Nearly two pints of pus evacuated. Irrigation, iodolorm and glycerin, solution of boric acid and carbolic acid. Permanent drainage with drainage-tube. After-treatment, twenty-six days. Death. No autopsy made, but a probe passed into pericardium discovered no adhesions, though soft granulations were felt towards base of heart.

CASE XX.—(Deaver, *University Medical Magazine*, 1894, Vol. vi, p. 297.) Date of operation, 1890. Male, aged twenty-one years. Ill eighteen days. Synovitis(?) of knee as complication. Aspiration one day previously. Incision, fifth interspace, three inches from middle line. Not much pus evacuated, but seventeen fluidounces removed by aspiration the day before. No irrigation. Permanent drainage with rubber tube. After-treatment, thirteen days. Death. Autopsy showed much fibrinous exudate within pericardium.

CASE XXI.—(Sievers, *Zeitsch. für klin. Med.*, 1893, Vol. xxiii, p. 26.) Date of operation, 1892. Female, aged twenty-two years. Ill five weeks. Pleuropneumonia, empyema on both sides, nephritis as complications. Tapped seven days previously with trocar. Incision, third interspace, two centimetres to left of sternum. Great quantity of pus evacuated. No irrigation. Permanent drainage. After-drainage, eight days. Death. Found bacilli in fluid. Autopsy showed acute nephritis, pleuropneumonia, pericardial adhesions, and some change in heart muscle. Pericarditis was of a septicæmic nature. Operator chose third interspace because fourth and fifth interspaces were very narrow.

CASE XXII.—(Körte, *Verhandel. d. Berlin. med. Gesellschaft* (1892), 1893, Vol. xxiii, p. 2.) Date of operation, 1891. Female, aged seven years. Osteomyelitis of both tibiae as complication. Tapped previously. Incision, with resection of five centimetres of fifth rib and cartilage. Evacuated half a litre of pus. Irrigation, lysol solution, $\frac{1}{2}$ per cent. Permanent drainage not mentioned. After-treatment, twelve days. Death. Autopsy showed numerous foci of pus in fissures of cardiac muscle, in papillary muscles of mitral valve, and in kidneys. Caseous mass in lung and evidence of pleuritis were found. Pus evacuated contained staphylococci, streptococci, and bacilli.

CASE XXIII.—(Eiselsberg, *Wiener klin. Wochenschrift*, January 10, 1895, p. 21.) Date of operation, 1894. Male, aged seventeen years. Ill over four and one-half months. Wound made by knife in region of heart, which had healed; left pleuritis, and pneumonia followed third tapping. Tapped three times previously. Resection of fourth cartilage. Two litres of pus evacuated. Irrigation, solution of salicylic acid; then iodoform and glycerin. Permanent drainage, two tubes. After-treatment, about six weeks. Recovered. Drains kept in pericardium seventeen days.

CASE XXIV.—(Edwards, *Transactions of the Medical Society of State of California*, 1893, p. 166.) Date of operation, 1892 (?). Female, aged six years. Sacculated empyema; operation with resection of ribs; mediastinitis, nephritis as complications. Not tapped previously. Incision, one-fourth inch within and above position of apex-beat. Nine fluidounces of pus evacuated. No irrigation. Permanent drainage with rubber tube. Death. Began as mediastinopericarditis, with secondary pleurisy. At least, this was the belief of Edwards after an autopsy.

CASE XXV.—(Jacobson, "Operations of Surgery," London, 1897, p. 590.) Female, aged fourteen. œdema of lungs as complication. Incision, fifth interspace, right side, a little outside of sternum. Forty-six fluidounces of pus evacuated. Death occurred from œdema of lungs.

CASE XXVI.—(Gabszwiez, *Gaz. Leklarsh*, Warsaw, 1892, Vol. ii, Series 12, p. 1070.) Date of operation, 1892. Male, aged twenty-two years. Ill about one month. No complications. Not tapped previously. Resection of fifth costal cartilage. Large quantity of pus evacuated. Irrigation, boric acid solution. Permanent drainage by iodoform gauze for eighteen days. Recovered.

CASE XXVII.—(Robinson, *Lancet*, November 21, 1896, p. 1460.) Date of operation, 1893. Male, aged sixteen years. Ill twenty days.

Sore throat and swelling of left wrist were first symptoms. Aspiration one day previous. Resection of sixth rib. Two quarts of pus evacuated. No irrigation. Permanent drainage with one drainage-tube. After-treatment, about two months. Recovered.

CASE XXVIII.—(Marsh, *Lancet*, November 21, 1896, p. 1460.) Male, aged fourteen years. Incision below nipple. No permanent drainage. After-treatment, four days. Death.

CASE XXIX.—(Klefsberg, *Tidskrift i Militär*, Helsingord 17, Arg. 1892, Stockholm, from Shattuck and Porter, *Boston Medical and Surgical Journal*, May 6, 1897, p. 444.) Male, aged nineteen years. Influenza previously. Aspiration previously, and withdrawal of one hundred and fifty grammes of pus. Incision in fourth interspace. One litre of pus evacuated. After-treatment, six days. Death. Autopsy showed pus in right ankle and sternoclavicular joints.

CASE XXX.—(Bolm, *Deutsche medicinische Wochenschrift*, November 26, 1896, p. 769.) Date of operation, 1894. Male, aged thirty-three years. Ill one month. Influenza previously. Pleuropneumonia as complication. Tapped pericardium three times. Incision in third interspace. One litre of pus evacuated. Irrigated with boric acid solution. Permanent drainage with gauze. After-treatment, three months. Recovered. Schleich's infiltration method of local anesthesia was used. Wound closed in three weeks. Out of bed in four and one-half weeks. Well a year later.

CASE XXXI.—(Allen, personal communication from Dr. D. P. Allen, Cleveland, Ohio, to Dr. Roberts.) Date of operation, 1892. Male, aged eleven years. Empyema, requiring costal resection one year before. Aspiration of pericardium previously. Resection of sixth rib below and inside of left nipple. Two quarts of pus evacuated. Irrigation with sterile water. Permanent drainage with gauze. After-treatment, twenty days. Death.

CASE XXXII.—(Stoker (O'Carroll's patient), *Dublin Journal of Medical Science*, July, 1896, p. 11.) Date of operation, 1892. Male, aged twenty years. Ill thirty-four days. Pneumonia. Left pleural effusion subsequent to operation. Aspiration of pericardium five days previously. Incision in fourth interspace midway between nipple and sternum. No irrigation. Permanent drainage on third day by tube. After-treatment, thirty days. Death. Fränkel's diplococci found in pus.

CASE XXXIII.—(Bjorkmann or Hackzell, *Hygieia*, Stockholm, 1896, I. viii, Part 2, p. 189.) Date of operation, 1895 (?). Female, aged twelve years. Ill about three and one-half weeks; had influenza and pleuropneumonia previously. Aspirated previously in fourth interspace. Resection, fifth and sixth ribs. Evacuated from 400 to 500 cubic centimetres of pus. Irrigation with boric acid solution. Permanent drainage with two drainage-tubes. Duration of treatment, six weeks. Recovered. Pleural cavity was opened and some serum evacuated by resection. The pleural opening was then closed with sutures.

CASE XXXIV.—(Porter (Shattuck's patient), *Boston Medical and Surgical Journal*, May 6, 1897, p. 438.) Date of operation, 1895. Male, aged twenty-six years. Ill thirty-three days. Pneumonia before peri-

carditis. Empyema after pericardotomy, requiring resection. Aspiration two days previously. Incision in fifth interspace one and one-half inches to left of sternum. One quart of pus evacuated. Irrigation with sterile salt solution. Permanent drainage with two rubber tubes. Recovered. Pneumococcus found in pus. Pneumothorax and empyema occurred after pericardotomy. Pneumococci in pus from pleural sac. Erysipelas of back and shoulder occurred. On thirty-sixth day wound entirely healed. Empyema sinus finally closed in about ten months.

CASE XXXV.—(Garber, *Journal of American Medical Association*, June 26, 1897, p. 1223.) Date of operation, 1897. Female, aged twenty-one years. Ill two weeks. Pericarditis, caused by penetrating wound with steel crochet-needle. Not tapped previously. Incision in fifth interspace, one and one-half inches to the left of the sternum. Evacuated about one fluidounce of thick pus and also some pyrosanguinolent fluid. Irrigation with salt solution. Permanent drainage with gauze. After-treatment, twenty-four days. Recovered.

The preceding thirty-five cases are copied from Roberts's article in *Transactions of the American Surgical Association*, 1897, Vol. xv.

The following are all new cases, save cases of Pepper and Rullier, which were in Dr. Porter's former list.

CASE XXXVI.—(Brentano, *Deutsche med. Wochenschrift*, 1898, p. 506.) Child, seven years old. Complication of acute osteomyelitis. Symptoms of effusion on sixth day. Ten days later, pericardotomy after diagnostic puncture with Pravaz syringe. Resection, fifth cartilage. Much pus. Pyæmia. Death in twelve days.

CASE XXXVII.—(Brentano, *ibid.*) Child, seven years old. Osteomyelitis. Practically the same as above.

The operation in these two children was followed immediately by improvement in pulse and general condition, but within a few days (twelve), as shown by post-mortem, pyæmia caused death. No cultures from pus reported. At post-mortem the following unusual condition was found. Abscesses, multiple in the muscle of the heart itself in both cases, one of which in second case had perforated into the left ventricle by extensive involvement of the walls of ventricle, and caused sudden death by great haemorrhage into the drained pericardium.

CASE XXXVIII.—(Brentano, *ibid.*) Male, fifteen years old. Rheumatic endocarditis and subacute serofibrinous pericarditis. Resection of

the fifth cartilage after incision, presumably in fifth space without resection, had injured pleura. Pericardium very thick, fibrinous adhesions to wall of the heart. Serofibrinous fluid. No cultures. Death in three days, with practically no improvement in symptoms.

CASE XXXIX.—(Brentano, *ibid.*) Male, thirty-one years old. Practically same as above, save that resection of rib cartilage was at once begun.

In these cases he thinks operation was a mistake because of the chronic cardiac and rheumatic condition. It does not appear from his article what symptoms and signs caused him to operate.

In these two cases, so adherent was heart and pericardium, puncture, he says, could hardly have failed to have done serious mischief.

CASE XL.—(Brentano, *ibid.*) A case of serous pericarditis following rheumatic endocarditis in a girl aged ten. Very sick case from large exudation. No puncture, but incision after resection of the fifth rib cartilage. Three hundred cubic centimetres of serosanguinolent fluid removed. No cultures reported. Immediate and marked improvement. Drainage with iodoform gauze. Fluid, clear, flowed from the wound for a day or two, but in eight days only a fine granulating dry sinus was left. Recovery.

CASE XLI.—(Lilienthal, Reported before New York Academy of Medicine, November 13, 1899, *Medical News*, November 25, 1899.) Male, fifteen years old. Trilobar pneumonia with very high fever, pneumococci in sputum, and later streptococci. Six weeks after very sick; pericardial friction sounds and dulness; aspirated, and eighteen ounces of pus, giving pure culture pneumococcus, withdrawn. Then, under cocaine local anaesthesia, incision, with resection of fourth and fifth costal cartilages; pericardial sac much thickened; pleura not opened. Forty ounces of pus. Irrigation with salt solution. Wound left open, no drainage-tubes or gauze. Recovery. Adhesion of pericardium and the heart with the scar was evident after recovery, by the retraction of the tissues at each systole.

CASE XLII.—(Allingham and Ogle, *Lancet*, March 10, 1900.) Male, twenty-six years old(?). Pericardial infection from small collection of pus in pleural cavity to right of pericardium. Chronic disease of lungs. No acute sepsis. Symptoms of pericardial effusion baffling. Incision and resection of fifth rib cartilage. Pleura not opened. Pericardium and pleura firmly adherent to chest wall. Sixteen ounces of non-offensive pus evacuated. No cultures. Great masses of fibrin in sac and adhering to sac and to heart. As much of this as possible removed with fingers and sponges; about five ounces back of heart could not be reached. Sac stitched to skin. Irrigation with hot water. Drainage not mentioned, but wound was left open. Temporary improvement. Death in fourteen hours. Autopsy revealed cause of infection.

CASE XLIII.—(Robinson, *British Medical Journal*, November 26, 1898.) Boy, four years old. Bronchopneumonia for three and one-half weeks. Operated when nearly moribund. Kind of anesthesia not given. Incision over fifth cartilage, one inch removed. Pleura not opened. Ten ounces of pus and seroturbid fluid. Cultures showed pure cultures of pneumococcus. Fibrin on anterior wall pericardium. No irrigation. Gauze drainage. Marked improvement after operation for twenty-four hours. Death on third day after operation. No post-mortem.

CASE XLIV.—(Sevestre, *Laucet*, April 23, 1898.) Male, twenty-two years old. Acute pneumonia and pneumococcus pericarditis. Very sick case. Aspiration in fourth space close to left border of the sternum, twenty-three ounces of pus giving pure cultures pneumococcus. Under cocaine the next day, as preliminary to operation, aspirating needle put in the same place, with result of getting only bright blood. Three days after the operation under cocaine(?) in fourth space. No mention of pleura made. No resection. Forty-five ounces of pus evacuated. Sac washed out and drainage-tube put in. Three days after this double empyema and resection of a rib on both sides under chloroform (at intervals of two days), pneumococci in pleural pus. Death, eighteen days after first pericardial aspiration (probable infection of pleural cavities at first operation).

CASE XLV.—(C. Mausell-Moulin, *Transactions of the Clinical Society*, Vol. xxx, p. 217, 1897.) Male, twenty-eight years old. Blow over chest while playing foot-ball. Collapse, soon after followed by cardiac dulness next day with cough and pain on breathing. Continued for nearly a month with less pain and easier breathing, except that cardiac dulness increased, spreading to right of sternum. About a month after injury, sudden great dyspnea and pain. Operation under cocaine anesthesia. Incision through fifth space. Nothing said about resection. Pleura opened. About six pints of thin, dark, bloody fluid, which clotted very rapidly, was removed. Drainage-tube left in for twenty-four hours. Good recovery, though left lung remained collapsed for very long time. No cultures mentioned.

CASE XLVI.—(Connor and Stimson, *Medical News*, January 20, 1900.) Sex and age unknown. Severe pneumonia. Operation under local anesthesia. Pleura (right opened), incision not given. Death in a few days.

CASE XLVII.—Bexman. Incision in second space for purulent pericarditis. Recovery. Mentioned by Voinitsch-Sianojewsky elsewhere.

CASE XLVIII.—(Ljunggren. Translated from history of the case in *Nordisk Med. Arkiv.*, Stockholm, 1898, Band ix, Heft 6, New Series.) Male, laborer, twenty-four years old. Well previously, save that some years before had disease in his left lung, the nature of which he did not know. On October 28, 1896, had a severe chill with fever, also shortness of breath and coughing, and pain in the left breast in front. Could not get up. Could not lie on the left side without very difficult breathing. Cough and fever continued till he was admitted to hospital the 17th of November. On entering hospital this condition was noted: The left half of chest is more prominent than the right, with dulness on percussion over

whole left front from second rib down; this dulness reached to about one centimetre to the right of the right sternal border and over the entire lower half of the thorax to the back and as high as the top of the scapula. Respiratory sounds could not be heard over any of this dull area. Heart beats could not be felt. Heart sound could be heard, though faintly. Distention of abdomen, especially epigastrie. Liver dulness lost. Breathing of the costal type and frequent. The face was cyanosed and anxious. There was some oedema of the feet. Temperature was 39.5° C. Pulse even and weak, 110. Pain over left chest, and difficulty in breathing complained of by patient. Under expectant treatment he became worse each day. Tapped twice in the back for supposed empyema without result, no fluid found. As the fever lessened, breathing became more difficult and heart's action weaker. Aspiration (diagnostic) with hypodermic needle in the fifth intercostal space a little below and inside of the left nipple, where fluctuation was felt. Under a small amount of chloroform an incision in fifth space beginning two centimetres inside and below nipple and ending six centimetres outside. The pleura was adherent. Pericardium opened with great spouting up of pus as result. Collapse of patient, pulse stopped, but compression of left ventricle of heart with operator's fingers caused renewed beating, after this the sac was emptied slowly. Heart was close up to sac wall with a few adhesions between. One and one-half litres of bright green pus were removed. The most of the fluid was localized back and at the sides of the heart. Drainage-tubes to back of sac. From pus several cultures were taken, but growths were doubtful. Microscopic examination showed short bacilli that often lay two and two. Cultures from fluid on second day gave *bacillus pyoeyaneus*. Steady improvement. On second day considerable fibrin in lumps came from wound. At end of a week after operation no fever and very little difficulty in breathing. At second week after irrigation with salt solution brought away coagula of fibrin. Irrigation about every three days. Because of contraction of sinns through the fifth space, operated on again to get more room for irrigation and resected the fifth rib, and through this larger opening kept on trying to keep sac clear of fibrin, etc., by irrigation. After this second operation, steady improvement and ultimate recovery. One year after operation normal cardiac dulness and minute fistula, which discharged occasionally.

CASE XLIX.—(Riedel, *Centralbl. f. Chir.*, 1897, p. 59.) Man. Pistol wound. Ten days afterwards resection of several ribs and opening of pericardium. Sanguinous fluid. Could not drain the sac because of tubes causing irregular pulse. Death. No other details given.

SYNOPSIS OF CASES OF OPERATION FOR SUPPURATIVE PERICARDITIS.

CASE I.—Male, twenty-five years. Operator, Hilsmann. Reference and Date, Inaug. Dissert., Kiel, 1875; date of operation, 1844. Etiology not given. Incision and Technique, fourth interspace near sternum; pericardium opened without first aspirating. Irrigation, Drainage, no irrigation; daily probing of wound. Result, recovered in three months.

CASE II.—(?). *Operator*, Langenbeck. *Reference and Date*, Vorlesungen über Chirurgie, p. 449, Berlin, 1888. *Etiology*, gunshot wound, with necrosis of fifth rib. *Incision and Technique*, incision through lost rib substance. *Irrigation, Drainage*, no irrigation; drainage (?). *Result*, recovered.

CASE III.—Male, sixteen years. *Operator*, Rosenstein. *Reference and Date*, Berlin, k. Woch., January 31, 1881; operation, 1879. *Etiology*, pleurisy (?); as to primary cause, etiology doubtful. *Incision and Technique*, tapped once; incision in fourth space near sternum. *Irrigation, Drainage*, no irrigation; drained with rubber tubes. *Result*, recovered in two months. *Remarks, Bacteriology*, very large quantity of pus in sac.

CASE IV.—Male, sixteen years; *Operator*, West. *Reference and Date*, Medico-Chirurgical Transactions, 1883, p. 235. *Etiology*, etiology (?); perhaps tubercular; no complications. *Incision and Technique*, tapped first; incision in fifth space, line of nipple. *Irrigation, Drainage*, irrigation; carbolic 1-40; tube drainage. *Result*, recovered in five months. *Remarks, Bacteriology*, two quarts of pus. Rod-shaped bacteria tubercle bacillus (?).

CASE V.—Male, twenty-three years. *Operator*, Partzhevsky. *Reference and Date*, London Medical Record, February 15, 1883. *Etiology*, pleurisy (?). *Incision and Technique*, tapped twice; then incision in fourth space. *Irrigation, Drainage*, irrigation with salicylic acid; double-tube drainage. *Result*, death in thirty hours.

CASE VI.—Male, fourteen years. *Operator*, West. *Reference and Date*, British Medical Journal, December 8, 1883, and February 21, 1891. *Etiology*, Pneumonia and general sepsis. *Incision and Technique*, opened in operation for pleural effusion; site (?). *Irrigation, Drainage*, (?). *Result*, death in fourteen days. *Remarks, Bacteriology*, cause of death, general sepsis.

CASE VII.—Male, nine years. *Operators*, Savory, Brinton, Collyns. *Reference and Date*, St. Bartholomew's Hospital Reports, 1883, Vol. xix, p. 279. *Etiology*, septic pneumonia and pleurisy from multiple abscesses. *Incision and Technique*, incision in fifth space; pleura opened. *Irrigation, Drainage*, irrigation with Condy's fluid; tube drainage. *Result*, death in fifteen days. *Remarks, Bacteriology*, cause of death, pyæmia. Incision in anterior axillary line for empyema primarily.

CASE VIII.—Male, six years. *Operator*, Scott. *Reference and Date*, New Zealand Medical Journal, July, 1891, p. 268. *Etiology*, unknown; no complications. *Incision and Technique*, tapped once; incision in fifth space near apex of heart; pleura not mentioned. *Irrigation, Drainage*, irrigation with 1½ per cent. carbolic; two tube drains. *Result*, recovered; time (?). *Remarks, Bacteriology*, two incisions one inch apart; drain in each.

CASE IX.—Male, thirty-two years. *Operator*, Newman or Sterling. *Reference and Date*, Australian Medical Journal, July 15, 1885. *Etiology*, typhoid fever and pleurisy. *Incision and Technique*, aspirated five times; cut in third space, old trocar track. *Irrigation, Drainage*, irrigation,

iodine 1 to 10; tube drain. *Result*, death in five days. *Remarks*, *Bacteriology*, 174 ounces pus removed by five tappings.

CASE X.—Female, thirty-five years. *Operator*, Mikhailov. *Reference and Date*, London Medical Record, August 15, 1885. *Etiology*, bronchitis and pleural lesion (?). *Incision and Technique*, tapped previously; cut in fourth space near sternum; pleura not mentioned. *Irrigation, Drainage*, boric acid; tube. *Result*, death in eighteen hours. *Remarks*, *Bacteriology*, bacteriological examination of sac (?) at autopsy was negative.

CASE XI.—Male, thirteen years. *Operator*, Gusenbauer. *Reference and Date*, Wien. med. Wochen., November 22, 1884. *Etiology*, osteomyelitis, acute. *Incision and Technique*, resection of fifth rib; pleura opened. *Irrigation, Drainage*, thymol solution; sac stitched up. *Result*, recovered; time (?).

CASE XII.—Male, ten years. *Operators*, Rouse and Dickinson. *Reference and Date*, Transactions of the Clinical Society, 1889, p. 48. *Etiology*, abscesses of buttocks and fingers, with pleurisy. *Incision and Technique*, tapped three times; cut in fifth space on right; pleura not mentioned. *Irrigation, Drainage*, no irrigation; tube drainage. *Result*, recovered in two and one-half months.

CASE XIII.—Female, six years. *Operator*, Underhill. *Reference and Date*, Edinburgh Hospital Reports, 1896, p. 200. *Etiology*, pyæmia from periostitis tibie. *Incision and Technique*, tapped twice; incision in fifth interspace near sternum. *Irrigation, Drainage*, no irrigation; tube drainage. *Result*, death in five days. *Remarks*, *Bacteriology*, cause of death, pyæmia and hemorrhages from interior of pericardium.

CASE XIV.—Female, nine years. *Operator*, Parker. *Reference and Date*, Transactions of the Clinical Society, London, 1889, Vol. xxii, p. 60. *Etiology*, osteomyelitis and arthritis. *Incision and Technique*, tapped incision and resection of fifth cartilage; pleura not opened. *Irrigation, Drainage*, irrigation; death during this. *Result*, death on table. *Remarks*, *Bacteriology*, cause of death said to have been pressure on heart through poor return of irrigation fluid.

CASE XV.—Male, thirty-six years. *Operator*, Halsted. *Reference and Date*, University Medical Magazine, Vol. vi, p. 248; date of operation, 1890. *Etiology*, necrosis of nasal bones. *Incision and Technique*, incision in fourth space halfway between nipple and sternum; pleura not mentioned. *Irrigation, Drainage*, no irrigation; ganze drain. *Result*, death in seventeen days; pyæmia.

CASE XVI.—Male, (?). *Operator*, Delorme. *Reference and Date*, Revue de Chirurgie, 1895, Vol. xv, p. 1008. *Etiology*, empyema. *Incision and Technique*, incision in fourth space near sternum; only few drops of pus. *Irrigation, Drainage*, no irrigation or drainage. *Result*, death in few minutes. *Remarks*, *Bacteriology*, autopsy showed that anterior wall of heart was adherent; about a pint of pus was behind and at the sides of the adherent heart.

CASE XVII.—Male, six years. *Operator*, Davidson. *Reference and Date*, British Medical Journal, March 14, 1891. *Etiology*, pyæmia and septic pneumonia after necrosis of metatarsus. *Incision and Technique*,

aspiration; incision in fifth space. *Irrigation, Drainage*, no irrigation; tube drain. *Result*, death in seven days from sepsis.

CASE XVIII.—Male, six and three-quarters years. *Operator*, Davidson, second case. *Reference and Date*, British Medical Journal, March 14, 1891. *Etiology*, empyema. *Incision and Technique*, not tapped; first incision in fourth space near sternum. *Irrigation, Drainage*, no irrigation; tube drain. *Result*, recovered in seven weeks.

CASE XIX.—Female, eleven years. *Operator*, Teale or Bromer. *Reference and Date*, British Medical Journal, February 14, 1891. *Etiology*, pneumonia and empyema. *Incision and Technique*, tapped; first incision in fourth space one inch from sternum. *Irrigation, Drainage*, boric and carbolic acid, iodoform, glycerin; tube drain. *Result*, death in twenty-six days. *Remarks*, *Bacteriology*, no autopsy.

CASE XX.—Male, twenty-one years. *Operator*, Deaver. *Reference and Date*, University Medical Magazine, 1894, Vol. vi, p. 297. *Etiology*, synovitis knee, probably septic. *Incision and Technique*, aspiration; incision in fifth space three inches from median line. *Irrigation, Drainage*, no irrigation; tube drain. *Result*, death in thirteen days. *Remarks*, *Bacteriology*, autopsy showed much fibrinous exudate in sac.

CASE XXI.—Female, twenty-two years. *Operator*, Sievers. *Reference and Date*, Zeitschrift f. klin. Med., 1893, xxiii, p. 26. *Etiology*, pneumonia and empyema (right). *Incision and Technique*, tapped seven days earlier; incision in third space near sternum; left pleura opened. *Irrigation, Drainage*, no irrigation; tube drain (?). *Result*, death in eight days; pyemia. *Remarks*, *Bacteriology*, bacilli (?) in pus; left empyema after operation.

CASE XXII.—Female, seven years. *Operator*, Körte. *Reference and Date*, Verhdl. d. Berlin. med. Gesellschaft, 1893, xxiii, 2; date of operation, 1891. *Etiology*, osteomyelitis of both tibiae. *Incision and Technique*, tapped previously; resection of fifth rib and cartilage. *Irrigation, Drainage*, irrigation, lysol, $\frac{1}{2}$ per cent.; drainage (?). *Result*, death in twelve hours from sepsis. *Remarks*, *Bacteriology*, pus, streptococci, staphylococci, and bacilli; abscess in heart wall found at autopsy.

CASE XXIII.—Male, seventeen years. *Operator*, Eiselsberg. *Reference and Date*, Wien. klin. Wochenschrift, January 10, 1895. *Etiology*, stab wound four and one-half months previously. *Incision and Technique*, tapped three times; resection of the fourth cartilage. *Irrigation, Drainage*, salicylic acid and iodoform glycerin; two tubes for seventeen days. *Result*, recovered in six weeks. *Remarks*, *Bacteriology*, early tapping caused pleurisy; pneumonia. Colon bacilli in fluid.

CASE XXIV.—Female, six years. *Operator*, Edwards. *Reference and Date*, Transactions of the Medical Society of California, 1893. *Etiology*, empyema, and operation for same; "mediastinitis" (?). *Incision and Technique*, incision one-half inch within and above apex-beat. *Irrigation, Drainage*, no irrigation; tube drain. *Result*, death. *Remarks*, *Bacteriology*, question as to priority of pericarditis or empyema.

CASE XXV.—Female, fourteen years. *Operator*, Jacobson. *Reference and Date*, "Operations of Surgery," London, 1897, p. 590. *Etiology*, un-

known. *Incision and Technique*, incision in right fifth space close to sternum. *Irrigation, Drainage*, (?). *Result*, death from œdema of lungs.

CASE XXVI.—Male, twenty-two years. *Operator*, Gabszwicz. *Reference and Date*, Roberts's list, also Gaz. Lekarski of Warsaw, 1892, second series. *Etiology*, unknown. *Incision and Technique*, resection of fifth cartilage. *Irrigation, Drainage*, boric acid, iodoform; gauze drain for eighteen days. *Result*, recovered.

CASE XXVII.—Male, sixteen years. *Operator*, Robinson. *Reference and Date*, Lancet, November 21, 1896, p. 1460. *Etiology*, sore throat, (?) septic. *Incision and Technique*, tapped previously; resection of sixth rib; left pleura opened. *Irrigation, Drainage*, no irrigation; tube drain. *Result*, recovered in two months. *Remarks, Bacteriology*, two quarts of pus; no cultures.

CASE XXVIII.—Male, eighteen years. *Operator*, Marsh. *Reference and Date*, Lancet, November 21, 1896, p. 1460. *Etiology*, not given or unknown. *Incision and Technique*, Incision below the nipple. *Irrigation, Drainage*, (?); no permanent drainage. *Result*, death in four days.

CASE XXIX.—Male, nineteen years. *Operator*, Klefburg, of Stockholm. *Reference and Date*, Dr. Porter's and Roberts's lists. *Etiology*, influenza. *Incision and Technique*, tapped previously; incision in fourth space; local anaesthesia. *Irrigation, Drainage*, (?). *Result*, death in six days; general sepsis.

CASE XXX.—Male, thirty-three years. *Operator*, Bolim. *Reference and Date*, Deutsche med. Wochenschrift, November 26, 1896. *Etiology*, influenza and pneumonia. *Incision and Technique*, tapped three times; incision in third space; local anaesthesia, Schleich. *Irrigation, Drainage*, boric acid; gauze drain. *Result*, recovered in four and one-half weeks.

CASE XXXI.—Male, eleven years. *Operator*, Allen, of Cleveland. *Reference and Date*, Roberts's list; date of operation, 1892. *Etiology*, (?) of old empyema. *Incision and Technique*, tapped previously; resection of sixth rib below and inside nipple. *Irrigation, Drainage*, sterile water; gauze drain. *Result*, death in twenty days.

CASE XXXII.—Male, twenty years. *Operator*, Stoker (O'Carroll's case). *Reference and Date*, Dublin Journal of Medical Sciences, July, 1896; date of operation, 1892. *Etiology*, pneumonia and pleural effusion. *Incision and Technique*, tapped previously; incision in fourth interspace between nipple and sternum. *Irrigation, Drainage*, no irrigation; tube drain. *Result*, death in thirty days. *Remarks, Bacteriology*, pneumococcus in pus.

CASE XXXIII.—Female, twelve years. *Operator*, Bjorkmann or Hackzell, of Stockholm. *Reference and Date*, Roberts's list. *Etiology*, influenza and pneumonia. *Incision and Technique*, tapped previously; resection of fifth and sixth ribs; pleura opened and sutured. *Irrigation, Drainage*, boric acid solution; two tubes. *Result*, recovered in six weeks.

CASE XXXIV.—Male, twenty-six years. *Operator*, C. B. Porter. *Reference and Date*, Boston Medical and Surgical Journal, May 6, 1897; also Transactions of the American Surgical Association, 1897. *Etiology*, pneumonia. *Incision and Technique*, tapped previously; incision in fifth

space one and one-half inches to left of sternum. *Irrigation, Drainage*, salt solution; two tubes. *Result*, recovered. *Remarks, Bacteriology*, empyema; pneumothorax after operation. Pneumococci in pus from pericardium and empyema.

CASE XXXV.—Female, twenty-one years. *Operator*, Garber. *Reference and Date*, Journal of the American Medical Association, June 26, 1897. *Etiology*, stab wound, needle, two weeks before. *Incision and Technique*, incision in fifth space one and one-half inches left of sternum. *Irrigation, Drainage*, salt solution; ganz drain. *Result*, recovered in twenty-four days. *Remarks, Bacteriology*, sanguinolent fluid and about one ounce of pus; no cultures.

The above thirty-five cases are all given in Roberts's list.

The following sixteen cases (two in Dr. Porter's list, Pepper's case and Rullier's) have been found and tabulated.

CASE XXXVI.—*Operator*, Beman. *Reference and Date*, cited by Voinitsch-Sianojewsky, Revue de Chirurgie, 1898, p. 993; date of operation, 1892. *Etiology*, unknown. *Incision and Technique*, incision in second space. *Irrigation, Drainage*, (?). *Result*, recovered.

CASE XXXVII.—Male, age (?). *Operator*, Riedal. *Etiology*, pistol wound ten days before. *Incision and Technique*, resection of several ribs and opening pericardium; no details given. *Irrigation, Drainage*, (?); no drainage. *Result*, death. *Remarks, Bacteriology*, bloody, thin fluid; no cultures. Resection of rib to drain right pleura after wound; for pericardotomy ten days later.

CASE XXXVIII.—*Operator*, Ljunggren, of Stockholm. *Reference and Date*, Nord. Med. Arkiv., U. S., 1898, Band ix, Heft 6. *Etiology*, acute pneumonitis. *Incision and Technique*, diagnostic aspiration; incision in fifth space between sternum and nipple; later resection of fifth rib. *Irrigation, Drainage*, salt solution; two tubes. *Result*, recovered. *Remarks, Bacteriology*, bacillus pyoeyanens in pus which was green in color.

CASE XXXIX.—Male, fifteen years. *Operator*, Lilenthal. *Reference and Date*, Medical News, November 25, 1899. *Etiology*, severe double pneumonia. *Incision and Technique*, aspirated once; incision with resection of fourth and fifth cartilages with cocaine; pleura not opened. *Irrigation, Drainage*, salt solution; no drain; wound left open. *Result*, recovered in six weeks. *Remarks, Bacteriology*, pneumococci in pus in pure culture; pneumococcus and streptococcus in sputum.

CASE XL.—Male, twenty-six years. *Operators*, Allingham and Ogle. *Reference and Date*, Lancet, March 10, 1900. *Etiology*, old purulent cysted pleurisy; no acute course. *Incision and Technique*, resection of fifth cartilage; pleura not opened. *Irrigation, Drainage*, hot water; sac stitched up; no drain. *Result*, death in fourteen hours. *Remarks, Bacteriology*, sixteen ounces of pus, no cultures. Much fibrin in pus.

CASE XLI.—Male, four years. *Operator*, Robinson (his second case). *Reference and Date*, British Medical Journal, November 26, 1898. *Etiology*, severe broncho-pneumonia. *Incision and Technique*, resection of fifth cartilage; pleura not opened. *Irrigation, Drainage*, no irrigation;

gauze drain. *Result*, death in three days. *Remarks*, *Bacteriology*, seropurulent fluid giving pure pneumococcus culture.

CASE XLII.—Male, twenty-two years. *Operator*, Sevestre. *Reference and Date*, Lancet, April 23, 1898. *Etiology*, acute pneumonia. *Incision and Technique*, aspiration; under cocaine, incision in fourth space; pleura not mentioned. *Irrigation, Drainage*, hot water; tube drain. *Result*, death in twelve days. *Remarks*, *Bacteriology*, pneumococcus pure. Double empyema with double rib resections later.

CASE XLIII.—Male, twenty-eight years. *Operator*, Mansell-Moulin. *Reference and Date*, Clinical Society Transactions, 1897, Vol. xxx, p. 217. *Etiology*, blow on chest one month before. *Incision and Technique*, under cocaine, incision in fifth space; pleura opened. *Irrigation, Drainage*, no irrigation; tube for twenty-four hours. *Result*, recovery. *Remarks*, *Bacteriology*, thin, bloody fluid; no cultures. Lung collapsed for long time.

CASE XLIV.—(?). *Operators*, Connor and Stimson. *Reference and Date*, Medical News, January 20, 1900. *Etiology*, acute pneumonia, severe. *Incision and Technique*, under cocaine, incision on left, location not given; right pleura opened. *Irrigation, Drainage*, (?). *Result*, death in a few days.

CASE XLV.—Child, seven years. *Operator*, Brentano, first case. *Reference and Date*, Deutsche med. Wochenschrift, 1898, p. 506. *Etiology*, acute osteomyelitis. *Incision and Technique*, resection of fifth cartilage; pleura not opened. *Irrigation, Drainage*, irrigation; drainage with iodoform gauze. *Result*, death in ten days. *Remarks*, *Bacteriology*, no cultures; death due to pyæmia; abscess in heart wall.

CASE XLVI.—Child, seven years. *Operator*, Brentano, second case. *Reference and Date*, Deutsche med. Wochenschrift, 1898, p. 506. *Etiology*, acute osteomyelitis. *Incision and Technique*, resection of fifth cartilage; pleura not opened. *Irrigation, Drainage*, irrigation; drainage with iodoform gauze. *Result*, death in ten days. *Remarks*, *Bacteriology*, profuse haemorrhage from sac, from ruptured heart, cause of death.

CASE XLVII.—Male, fifteen years. *Operator*, Brentano, third case. *Reference and Date*, Deutsche med. Wochenschrift, 1898, p. 506. *Etiology*, rheumatism, endocarditis. *Incision and Technique*, resection of fifth cartilage; pleura injured. *Irrigation, Drainage*, irrigation; iodoform gauze drain. *Result*, death in three days. *Remarks*, *Bacteriology*, serofibrinous fluid in sac; no cultures.

CASE XLVIII.—Male, thirty-one years. *Operator*, Brentano, fourth case. *Reference and Date*, Deutsche med. Wochenschrift, 1898, p. 506. *Etiology*, rheumatism, endocarditis. *Incision and Technique*, resection of fifth cartilage; pleura not cut. *Irrigation, Drainage*, irrigation; iodoform gauze drain. *Result*, death. *Remarks*, *Bacteriology*, serofibrinous fluid; no cultures; heart adherent.

CASE XLIX.—Female, ten years. *Operator*, Brentano, fifth case. *Reference and Date*, Deutsch. med. Wochenschrift, 1898, p. 506. *Etiology*, rheumatism, endocarditis. *Incision and Technique*, resection of fifth cartilage. *Irrigation, Drainage*, irrigation; iodoform gauze drain. *Result*,

recovery in ten days. *Remarks, Bacteriology*, serous fluid only; no cultures.

CASE L.—Male, nineteen. *Operator*, Pepper, C. B. Porter's list. *Reference and Date*, University Medical Magazine, February, 1894. *Etiology*, influenza. *Incision and Technique*, aspiration first; small incision and tube in fifth space. *Irrigation, Dripping*, (?). *Result*, death in two days. *Remarks, Bacteriology*, at autopsy little pus, but whole sac distended with fibrin.

CASE LI.—*Operator*, Rullier, C. B. Porter's list. *Reference and Date*, see Dr. Porter's paper. *Etiology*, serous pericarditis. *Incision and Technique*, tapped four times; iodine injected; incision in fourth space. *Result*, recovered.

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